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shows an extensive region with villages dotted here and there and the winding roads that connect them. At the highest altitudes the aeronaut rode in the clear sky above the clouds, and his camera caught the glorious view of their upper surfaces resembling a frozen sea. The work is both unique and interesting.

Geology. By Thomas C. Chamberlin and Rollin D. Salisbury. In two volumes. Vol. I. Geologic Processes and their Results. New York, Henry Holt & Company, 1904. Pp. xx, 654. Pl. 24, Tables 3, Figs. 471. Published in the American Science Series, Advanced Course.

In this volume the authors, as a result of their long experience as instructors of geology, have departed considerably from the usual method of text-book treatment of the broad science under discussion. To quote from the preface:

> Little emphasis is laid on the commonly recognized subdivisions of the science, such as *dynamic geology, stratigraphic geology, physiographic geology*, etc. The treatment proceeds rather from the point of view that the science is a unit, that its one theme is *the history of the earth*, and that the discussions of dynamic geology, physiographic geology, etc., apart from their historical bearing, lose much of their significance and interest.

As far as possible the inductive methods of the practical geologist are made use of in the treatment of the different topics, and "the theoretical and interpretative elements which enter into the general conceptions of geology have been freely used." The effort, however, is made throughout to lead the student to "avoid confusing the interpretations based on hypothesis with the statements of fact and established doctrine," and "alternative hypothesis and alternative interpretations are frequently presented where knowledge does not warrant positive conclusions."

The book contains a wealth of new material drawn from many sources, in addition to the wide personal observations of the authors, but particularly from the publications and collections of the United States Geological Survey. It is essentially a treatise on North American geology, but this is a decided advantage in the discussion of the broad principles of the science. The development of national, state, and other geological surveys—a development with which photography as an assistant to the geologist has kept pace—has been very great during the past ten or fifteen years. Hence the new material at hand, for purposes of illustration, is extensive, and half-tone reproductions are scattered liberally through the book. The maps, thirty-eight in number, form a noteworthy and satisfactory feature of the book. They are from the sheets prepared by the United States Geological Survey, and are printed in three colours, like the originals.

The chapter on the Work of Running Water will be found of great interest to the general reader, on account of the discussion of many processes, the results of which are patent to the most casual observer. This chapter, together with those on the Atmosphere as a Geological Agent, and on the Work of Ground (underground) Water, the Work of Snow and Ice, and the Work of the Ocean, gives all the essentials of the modern science of physiography in succinct form and in clear demonstration. These chapters elaborate these topics more fully than is customary in text-books, because they discuss phenomena which are encountered everywhere. The common, rather than the usual phases of the phenomena, are presented on account of their greater importance, as well as their accessibility.

The chapter upon the Work of Snow and Ice is particularly full of material which has not heretofore found its way into text-books, both authors having made special studies of glaciers and glaciation for many years. Glaciers are classified as ice caps or continental glaciers, polar or high-latitude valley glaciers, Alpine valley glaciers, piedmont glaciers, cliff glaciers, and reconstructed glaciers. Piedmont glaciers are formed by the coalition of the expanded fronts of adjacent polar valley glaciers, and are exemplified by the Malaspina glacier of Alaska. Cliff glaciers are restricted to a relatively small depression in the side of a mountain or in the escarpment of a plateau. A reconstructed glacier is formed at the base of a precipice over which the ice from an ice-sheet or valley glacier has fallen. The fragments become a coherent mass through regelation, and motion may be resumed.

In explanation of the phenomena of glaciers, the authors advance the theory "that a glacier is a crystalline rock of the purest and simplest type, and that it never has other than a crystalline state. This strictly crystalline character is incompatible with viscous liquidity." A glacier is considered to be a colossal aggregation of snow crystals to flakes of much greater sizes. Snow which has lain for some time on the ground becomes granular through thawing and freezing of crystals and aggregation around crystalline centres. Increase of size of granules goes on under all conditions of atmosphere, with steady diminution in total number of granules. Large granules grow at the expense of smaller ones. In glacier ice the axes of the crystals lie at all angles to one another. The initial or fundamental cause of glacial motion must be operative at the heads of the glaciers where the temperature is lowest and the material is most loosely granular. Movement of the mass takes place by the minute individual movements of the grains upon one another, and flowage is facilitated by the probable momentary liquefaction of minute portions of the mass under the influence of compression. The ice as a whole, however, remains rigid; it does not have the slow, viscous fluidity of asphalt or lava. Near the end or edge of a glacier there is a co-operation of rigid thrust from behind, with the tendency of the mass to move on its own account. This tendency is controlled by gravity, and conforms in its results to the laws of liquid flow.

The theory of the crystalline character of glaciers seems to offer a satisfactory explanation of the enormous amount of scouring, grooving, and planing that has been done by glaciers. If glacier ice were really viscous, its hold over imbedded débris should be viscous too, and a boulder in the bottom would roll over the rocky bed instead of grinding into it, as often has been done. According to the new theory, however, stones in the base of the glacier would be held with great rigidity when the ice is dry, scoring the bottom with vigour, while they might be rotated with ease when the ice was wet. This view, too, would explain crevasses and other evidences of brittleness and movement on upward slopes even when the upper as well as the lower surface is inclined backward.

In the chapter on the Origin and Descent of Rocks, an epitome is given of petrology in which the results of the latest researches in this difficult branch of study are applied to old topics. Rocks of igneous origin are broadly separated into pyroclastics, the glassy rocks or obsidians, the porphyritic rocks or porphyries, and the phanero-crystalline rocks or phanerites. The newly-proposed system of classification and nomenclature advanced by Cross, Iddings, Pirsson, and Washington is briefly and clearly reviewed. A feature of this new classification, which appeals to student and reader alike, is the definition and limitation of some familiar rock-names so that they have certain broad, generalized meanings. The names which thus become of wider significance than heretofore for convenience in field work are granite, syenite, diorite, gabbro, dolerite, peridotite, pyroxenite, and hornblendite. The new and more rigorous system, which is designed to meet the needs of the professional petrologist, is dependent upon quantitative chemical characteristics, and all igneous rocks are classified primarily according to chemical composition, and only secondarily according to mineral constituents, texture, and other characters. The old separation into plutonics and volcanics as a fundamental differentiation is entirely abandoned, the American school of petrology, at least, no longer thinking that an igneous rock should receive different names and be assigned to two or more systematic positions on account of fortuitous circumstances of solidification.

One looks with especial eagerness for the discussion of the various theories which have been advanced to account for the origin of the earth. The full discussion of the accretion or "planetissimal" theory is to come in the second volume, but an outline of the hypothesis is given in the section of the present volume on the distribution of heat. The senior author is the originator of this new theory, which supposes that

> the earth was built up gradually by the infall of matter, bit by bit, at such a rate that though each little mass became hot as a result of its fall, it cooled off before others fell on the same spot, the rain of matter not being fast enough to heat up the whole mass to the melting point,

and that

> the internal heat was gradually developed from the centre outwards as the earth grew and the internal compression (due to gravity) was progressively developed.

Two other hypotheses are stated, and the respects in which they fail of explaining known phenomena are pointed out. Both depend upon the idea, commonly known as the Nebular Hypothesis of Laplace, that the earth has passed through gaseous and liquid conditions to a solid state, one school holding that the solidification proceeded from the exterior inward by reason of uniform cooling, due to convection, while the other school contends that pressure caused solidification at the centre first, in spite of the high temperature. The latter view excludes transfer of heat by convection between different zones, beginning with the centre as soon as solidification or prohibitive viscosity obtained.

The accretion hypothesis supposes the earth to be of variable composition on account of presumable variation in the nature of the infalling bodies making up the globe. Chemical and physical recombination would be slow in progress. Volcanic action would transfer large amounts of heat as well as material from inner zones to outer ones, and even to the surface—a process which still continues, though less actively than in earlier ages. Liquid matter is thus supposed to be forced outwards or extended as soon as formed, and to continue to form and to rise until the temperature of the region affected is adjusted again to the conditions producing solidity. Shrinkage affects all zones, and may even originate in the deeper. Double distortional effects result. On account of the thick segments concerned, stresses may accumulate, and thus bring about extensive movements after long periods of rest.

The difficulties in the path of the modern vulcanologist are clearly indicated in the discussion of six theories which have been advanced to account for the origin of lavas and forces which expel them. After a succinct statement of the theories and of the objections to them, the authors briefly outline the explanation of the phenomena of vulcanism according to the accretion hypothesis, leaving the full treatment of the subject for the second volume. Water is evidently one of the most powerful agents in an explosive eruption, but, according to the new theory, the chief source of this substance is the deep interior, and not the surface. In fact, the volcanic gases (including steam) are additions to the atmosphere and the hydrosphere. The general force of extrusion is considered to lie in deep-seated periodic and other stresses, and the slow pressure, due to creep of the rock adjacent, to the supposed slender threads of liquid rock. The frequent pauses in action are assigned to temporary deficiencies of supply; the renewals to the gathering of new supplies after a sufficient period of accumulation.

The concluding chapter of the volume is devoted to a presentation of the geologic functions of life, and may be considered introductory to Volume II, which is to treat of historical geology. The discussion here of the contributions to the rocks made by the different classes of plants and animals will be found highly suggestive.

The book is well printed on heavy-coated paper. The paper makes it ponderous, and the highly-glazed surface is somewhat trying to the eyes, unless the angle at which the light comes in is just right, but the resulting excellent character of the abundant halftone illustrations is a compensating advantage. The volume is a welcome addition to the series of treatises upon geologic science, and its clear, succinct, interesting style commends it most highly to the general reader as well as to the student and professional geologist.

E. O. H.

The Expansion of Russia, 1815–1900. By Francis Henry Skrine. viii and 386 pp., Index, and 3 maps. The University Press, Cambridge, England.

This volume appears in the Cambridge Historical Series, whose aim is to facilitate the work of those who desire to understand the existing political conditions in the various States of modern Europe.